

Sternotomy Closure Articles

1. Pai, Shruti, BS Najmuddin, et. al., **In vitro comparison of wire and plate fixation for midline sternotomies.** *Annals of Thoracic Surgery*, 962-969, 2005.
 - Rigid plate fixation significantly reduced lateral motion relative to wire fixation.
 - The lower sternal region most noticeably benefitted from plate fixation as the splaying observed for wire fixation was reduced.
 - Under these loading conditions, plating increased stability at the midline compared to wires; this increased stability may facilitate the recovery of high-risk patients undergoing cardiac operation.
 - Pai and colleagues observed that plates provided more stable fixation in the xiphoid region, where the largest separation typically occurs.
2. McGregor, Walter E., Maryann Payne, Dennis R. Trumble, et. al., **Improvement of sternal closure stability with reinforced steel wires.** *Annals of Thoracic Surgery*, 76:1631-4, 2003
 - Higher intrathoracic pressures were required to cause separation in sterna closed with reinforced wires.
 - The use of these coils permits continued use of steel wire, which is familiar to all surgeons. Their low-profile nature allows easy application at the xiphoid, which is known to be the most unstable area of sternotomy closure.
3. Casha, AR, L. Yang, PH Kay, M. Saleh, Gary Cooper, **A biomechanical study of median sternotomy, closure techniques.** *European Journal of Cardio-Thoracic Surgery*, 15:365-9, 1999
 - After this testing, it has been concluded that sever coughing may cause wires to untwist.
4. McGregor, Walter E, Dennis R. Trumble, James A Magovern, **Mechanical Analysis of Midline Sternotomy Wound Closure.** *Journal of Thoracic and Cardiovascular Surgery*, 1144-1150, 1999
 - The data suggests that standard sternal closure methods for which multiple twisted wires are used may not always provide sufficient mechanical stability to allow proper wound healing, especially near the xiphoid.
 - Results from this study show that the traditional sternal closure technique with interrupted stainless steel wire does not always provide adequate fixation when the closure is subjected to physiologic mechanical stress.
 - Improved closure methods should distribute the force of the closure over a larger surface area and provide firmer fixation of the lower aspect of the sternum, especially in relation to lateral stress.
5. Wangsgard, Cameron, David J Cohen, Lanny V Griffin, **Fatigue testing of three peristernal median sternotomy closure techniques.** *Journal of Cardiothoracic Surgery*, 3:52, 2008
 - A sternotomy closure system that uses either stainless-steel cables or plates to distribute local stresses of the wires on the sternum will be less prone to fatigue-based failure when compared to wires.
 - Under distraction loading, only 43% of figure-of-eight stainless-steel wire closure devices are predicted to survive for 50,000 cycles and by 100,000 cycles, nearly all these constructs will have failed.

6. Shih, Chun-Ming, Yea-Yang Su, Shing-Jong in, Chun-Che Shih, **Failure Analysis of explanted sternal wires**. *Biomaterials*, 2053-2059, 2004
 - The synergic effect of hostile environment and the stress could be the precursors of failures for sternal wires.

7. Shih, Chun-Ming, Yea-Yang Su, Shing-Jong in, Chun-Che Shih, **Potential Risk of Sternal Wires**. *European Journal of Cardio-Thoracic Surgery*, 812-818, 2004
 - The synergic effect of stress and poor wire quality could be the precursors of material failure for the sternal wire.
 - The induced or derived strength from the sternotomy closure could exceed the UTS of the suture wire when severe surface defects such as the transversal cracks and inclusions were found on the retrieved sternal wires.
 - Wire is susceptible to fracture under pressure or strength due to the huge difference of hardness between the surface martensite and the internal austensite structure as well as the stress concentration factor.
 - To prevent the occurrence of sternal wire failure after closure, improvement of sternal wire quality is mandatory.